PATENT COOPERATION TREATY
Amendment Under Article 34

Inventor: William L. Rubin
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In response to the International Search Report of 08July2005, please amend the above identified application as follows:

In the specification:

page 20 line 7 delete "above" and insert therefore --below--

line 8 delete "400" and insert therefore --500--

line 8 delete second occurrence of "for example"

The above corrections to the specification do not add new matter.

Substituting --below-- for "above" on line 7 is conformity with the remainder of the consistent with the beginning of the line which states "analog low pass filter" and Figure 5B wherein block 5-9 is designate "LPF" that is Low Pass Filter.

The amendment on line 8 is in conformity with "Based on a 500 Hz----" recited on line 11.

In the claims:

claim 1 line 3 delete "a computed" and insert --an-- therefore

line 5 delete "locations" and insert --existence-- therefore

claim 6 line 2 delete "detecting" and insert --providing-- therefore

add new claims 26 - 34 as follows:

26. A method for detecting atmospheric disturbances in accordance with claim 1 wherein said providing step includes the steps of;

extracting noise at frequencies below a specified frequency from said received noise spectra to provide an extracted noise spectra;

filtering said extracted noise spectra through a low pass filter to obtain infrasound at frequencies below a predetermined infrasound frequency; and

comparing magnitudes of said infrasound at frequencies below said predetermined infrasound frequency to a preselected magnitude.

27. A method for detecting atmospheric disturbances in accordance with claim 26 wherein said preselected magnitude is that of a preselected wind velocity.

28. A method for detecting atmospheric disturbances in accordance with claim 26 further including the steps of:

selecting a signal in said extracted noise spectra, thereby providing a selcted signal;

comparing said selected signal to a second predetermined threshold; and

deactivating said low pass filter when said signal exceeds said second predetermined threshold.

29. A method for detecting atmospheric disturbances in accordance with claim 26 wherein said providing step further includes the step of positioning sound sensors in a plurality of parallel rows positioned perpendicular to and centered on a foot print of an aircraft arrival glide slope.

30. A method for detecting atmospheric disturbances in accordance with claim 29 wherein each row contains at least 3 sensors.

31. A method for detecting atmospheric disturbances in accordance with claim 1 wherein said providing step includes the steps:

obtaining infrasound below a predetermined infrasound frequency, thereby providing extracted infrasound; and

detecting magnitudes of said extracted infrasound.

32. A method for detecting atmospheric disturbances in accordance with claim 31 wherein said obtaining step includes the steps of:

extracting noise at frequencies below a specified frequency from said received noise spectra to provide an extracted noise spectra; and

filtering said extracted noise spectra to obtain said extracted infrasound.

33. A method for detecting atmospheric disturbances in accordance with claim 31 wherein said providing step includes the step of positioning a noise sensor and said determining step includes the steps of:

delaying extracted infrasound for a predetermined time interval, thereby providing delayed extracted infrasound;

predicting a time of arrival at said noise sensor of an atmospheric disturbance causing a presently extracted infrasound with the utilization of said delayed extracted infrasound and said presently extracted infrasound.

34. A method for detecting atmospheric disturbances in accordance with claim 33 wherein said predicting step includes the steps of:

determining magnitudes of said delayed extracted infrasound and said presently extracted infrasound;

establishing a ratio of said magnitudes;

providing a square root of said ratio; and

utilizing said square root, said time delay, and velocity of said infrasound to predict said time of arrival.

35. A method for detecting atmospheric disturbances in accordance with claim 33 further including the steps of:

producing a signal when magnitudes of said extracted infrasound exceed said infrasound threshold for a predetermined time interval;

coupling said signal to a gate to which said time of arrival is also coupled; and

supplying said time of arrival through said gate when said signal is received.

36. A method for detecting atmospheric disturbances in accordance with claim 32 wherein said filtering step provides infrasound signals at frequencies below a preselected infrasound frequency and said determining step includes the steps of:

finding a bandwidth of said infrasound signals having amplitudes greater than a preselected amplitude;

calculating a mean frequency and rms amplitude for signals within said bandwidth;

comparing said bandwidth, said mean frequency, and said rms amplitude to respective predetermined thresholds; and

providing an alarm when said respective thresholds are simultaneously exceeded over a specified time interval.

All of the claims now in this application are given on the attached replacement pages, wherein claims 1 and 6 contain the amendments described above.

Respectfully submitted,

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I claim:

1. A method for detecting atmospheric disturbances including the steps of:

providing infrasound frequency magnitudes of received noise spectra;

comparing said infrasound frequency magnitudes to an infrasound threshold; and

determining existence of said atmospheric disturbances with the utilization of infrasound frequency magnitudes that exceed said threshold.

2. A method for detecting atmospheric disturbances in accordance with claim 1 wherein said providing step includes the steps of;

extracting noise at frequencies below a specified frequency from said received noise spectra to provide an extracted noise spectra;

filtering said extracted noise spectra to obtain infrasound at frequencies below a predetermined infrasound frequency; and

detecting magnitudes of infrasound frequencies below said predetermined infrasound frequency.

3. A method for detecting atmospheric disturbances in accordance with claim 2 wherein said extracting step includes the step of activating said filtering step when magnitudes of said extracted noise spectra exceed a preselected threshold.

4. A method for detecting atmospheric disturbances in accordance with claim 3 wherein said comparing step includes the steps of:

coupling infrasound obtained in said filtering step to an atmospheric disturbance detector and to a threshold computer;

computing a threshold in said threshold computer by averaging magnitudes of infrasound received prior to reception of infrasound generated by an atmospheric disturbance;

coupling said computed threshold to said atmospheric disturbance detector; and

establishing an existence of an atmospheric disturbance when infrasound coupled to said atmospheric detector exceeds said computed threshold.

5. A method for detecting atmospheric disturbances in accordance with claim 4 wherein said detecting step includes the step of establishing an existence of an atmospheric disturbance when infrasound coupled to said atmospheric disturbance detector exceeds said computed threshold.

6. A method for detecting atmospheric disturbances in accordance with claim 5 wherein said providing step further includes the step of positioning sound sensors in a manner to sense sound from a noise generating source and providing infrasound magnitudes respectively associated with said sensors.

7. A method for detecting atmospheric disturbances in accordance with claim 6 wherein said sound sensors are positioned in a row perpendicular to a foot print of a glide slope of an approaching aircraft with predetermined spacings therebetween.

8. A method for detecting atmospheric disturbances in accordance with claim 7 wherein said row of sound sensors is placed at a runway middle marker.

9. A method for detecting atmospheric disturbances in accordance with claim 7 further including the step of comparing extracted noise of a preselected sound sensor in said row of sound sensors to said preselected threshold.

10. A method for detecting atmospheric disturbances in accordance with claim 6 wherein said positioning step includes the step of locating parallel rows of sound sensors, each containing a multiplicity of said sound sensors, between runways at an airport.

11. A method for detecting atmospheric disturbances in accordance with claim 6 wherein said positioning step includes the step of locating a column of said sound sensors, with predetermined spacings therebetween, along a center line of an airport runway, a first sound sensor of said column being placed at a predetermined location.

12. A method for detecting atmospheric disturbances in accordance with claim 11 wherein said extracted noise is obtained from noise spectra received by at least one sound sensor including said first.

13. A method for detecting atmospheric disturbances in accordance with claim 12 wherein said filtering step and said detecting step are performed in sound sensors subsequent to said at least one sound sensor, said filtering step being activated by said extracted noise obtained from noise spectra received at said least one sound sensor.14.

A method for detecting atmospheric disturbances including the steps of:

sensing atmospheric noise to obtain noise signals;

filtering said noise signals to eliminate signals at frequencies above a predetermined frequency and providing signals at frequencies within a band of frequencies below said predetermined frequency;

comparing amplitudes of signals at frequencies in said band below said predetermined frequency to a first preselected threshold;

determining a representative amplitude and representative frequency for signals at frequencies in said band below said predetermined frequency that have amplitudes which exceed said first preselected threshold;

comparing said representative frequency to a predetermined frequency threshold;

comparing said representative amplitude to a second preselected threshold when said representative frequency exceeds said predetermined frequency threshold ; and

indicating when said representative amplitude exceeds said second preselected threshold.

15. The method of claim 14 wherein said filtering step includes the step of placing signals having frequencies within said band of frequencies in frequency bins and determining amplitudes and phases of signals in each bin.

16. The method of claim 15 wherein said amplitude comparing step includes the step of comparing said amplitudes of signals in each of said frequency bins to said first preselected threshold.

17. The method of claim 14 wherein:
said sensing step includes the step of
providing first and second sensors to obtain first and second noise signals, respectively;
said filtering step includes the steps of
establishing a first band of signals having frequencies below said predetermined frequency in said first noise signal and a second band of signals having frequencies below said predetermined frequency in said second noise signal; and
utilizing said first and second bands of signals to estimate an angle off a reference of said atmospheric disturbance and to estimate a range to said atmospheric disturbance.

18. The method of claim 17 wherein said utilizing step includes the steps of:
computing electrical phase differences between signals in said first band and signals in said second band; and
converting said electrical phase differences to said angle off said reference.

19. The method of claim 18 wherein said computing step computes phase differences between signals in said first band and signals in said second having equal frequencies.

20. The method of claim 17 wherein said establishing step includes the steps of:
placing signals having frequencies within said first band into first frequency bins and determining phases and amplitudes of signals in each of said first frequency bins;
placing signals having frequencies within said second band into second frequency bins and determining phases and amplitudes of signals in each of said second frequency bins.

21. The method of claim 20 further including the steps of:

determining phase differences between signals in bins of said first band and signals in corresponding bins of said second band, a bin in said first band and a corresponding bin in said second band comprising a bin set, thereby obtaining a bin set phase difference for each of said bin sets; and

utilizing said bin set phase differences to estimate an angle of said atmospheric disturbance from a reference direction.

22. The method of claim 21 wherein said utilizing step includes the steps of:

averaging signal amplitudes in bins of said first band with signal amplitudes in corresponding bins of said second band, to obtain a bin set average amplitude for each set of corresponding bins;

multiplying bin set average amplitudes by said bin set phase differences, respectively, to obtain set products of bin phase multiplied by bin average amplitude;

summing said set products over all bin sets, to obtain a sum of set products;

summing said set average amplitudes over all bin sets to obtain a sum of set average amplitudes; and

dividing said sum of set products by said sum of average amplitudes to obtain said estimate of said angle.

23. The method of claim 20 wherein said comparing amplitudes step includes the step of

comparing amplitudes of signals in said first band and amplitudes of signals in said second band to said first preselected threshold and removing signals from bins, in said first and second bands, with amplitudes that do not exceed said first preselected threshold; and further including the steps of:

combining amplitudes of signals in said first and second bands that exceed said first preselected threshold at a first location, to obtain a first combined amplitude signal and combining amplitudes of signals in said first and second bands that exceed said first preselected threshold at a second location, to obtain a second combined amplitude signal; using said first and second combined amplitude signals to estimate range to said atmospheric disturbance.

24. The method of claim 23 wherein said combining includes the steps of:

computing rms sum of signal amplitudes at said first location in said first and second frequency bins to obtain rms sum signals $A_1$ and $B_1$, respectively; and

computing rms sum of signal amplitudes at said second location in said first and second frequency bins to obtain rms sum signals $A_2$ and $B_2$, respectively.

25. The method of claim 24 wherein said using step includes the steps of:

averaging $A_1$ and $B_1$ to obtain an average signal $S_1$, and averaging $A_2$ and $B_2$ to obtain an average signal $S_2$;

forming a ratio $r = S_1/S_2$;

noting a difference in position of said first location and said second location, said difference in position being $X\cos\theta$, where X is a distance from said first location to said second location and $\theta$ is said angle off said reference; and

estimating range R to said atmospheric disturbance from $R = X\cos\theta/(r - 1)$.

26. A method for detecting atmospheric disturbances in accordance with claim 1 wherein said providing step includes the steps of;

extracting noise at frequencies below a specified frequency from said received noise spectra to provide an extracted noise spectra;

filtering said extracted noise spectra through a low pass filter to obtain infrasound at frequencies below a predetermined infrasound frequency; and

comparing magnitudes of said infrasound at frequencies below said predetermined infrasound frequency to a preselected magnitude.

27. A method for detecting atmospheric disturbances in accordance with claim 26 wherein said preselected magnitude is that of a preselected wind velocity.

28. A method for detecting atmospheric disturbances in accordance with claim 26 further including the steps of:

selecting a signal in said extracted noise spectra, thereby providing a selcted signal;

comparing said selected signal to a second predetermined threshold; and

deactivating said low pass filter when said signal exceeds said second predetermined threshold.

29. A method for detecting atmospheric disturbances in accordance with claim 26 wherein said providing step further includes the step of positioning sound sensors in a plurality of parallel rows positioned perpendicular to and centered on a foot print of an aircraft arrival glide slope.

30. A method for detecting atmospheric disturbances in accordance with claim 29 wherein each row contains at least 3 sensors.

31. A method for detecting atmospheric disturbances in accordance with claim 1 wherein said providing step includes the steps:

obtaining infrasound below a predetermined infrasound frequency, thereby providing extracted infrasound; and

detecting magnitudes of said extracted infrasound.

32. A method for detecting atmospheric disturbances in accordance with claim 31 wherein said obtaining step includes the steps of:

extracting noise at frequencies below a specified frequency from said received noise spectra to provide an extracted noise spectra; and

filtering said extracted noise spectra to obtain said extracted infrasound.

33. A method for detecting atmospheric disturbances in accordance with claim 31 wherein said providing step includes the step of positioning a noise sensor and said determining step includes the steps of:

delaying extracted infrasound for a predetermined time interval, thereby providing delayed extracted infrasound;

predicting a time of arrival at said noise sensor of an atmospheric disturbance causing a presently extracted infrasound with the utilization of said delayed extracted infrasound and said presently extracted infrasound.

34. A method for detecting atmospheric disturbances in accordance with claim 33 wherein said predicting step includes the steps of:

determining magnitudes of said delayed extracted infrasound and said presently extracted infrasound;

establishing a ratio of said magnitudes;

providing a square root of said ratio; and

utilizing said square root, said time delay, and velocity of said infrasound to predict said time of arrival.

35. A method for detecting atmospheric disturbances in accordance with claim 33 further including the steps of:

producing a signal when magnitudes of said extracted infrasound exceed said infrasound threshold for a predetermined time interval;

coupling said signal to a gate to which said time of arrival is also coupled; and

supplying said time of arrival through said gate when said signal is received.

36. A method for detecting atmospheric disturbances in accordance with claim 32 wherein said filtering step provides infrasound signals at frequencies below a preselected infrasound frequency and said determining step includes the steps of:

finding a bandwidth of said infrasound signals having amplitudes greater than a preselected amplitude;

calculating a mean frequency and rms amplitude for signals within said bandwidth;

comparing said bandwidth, said mean frequency, and said rms amplitude to respective predetermined thresholds; and

providing an alarm when said respective thresholds are simultaneously exceeded over a specified time interval.